5.0 CUMULATIVE IMPACTS

This section presents an analysis of the cumulative effects (beneficial or adverse) on the environment of the three Bull Run Habitat Conservation Plan alternatives evaluated in this EIS. The cumulative effects are considered in the context of other local, state, and Federal management activities and projects in the Sandy River Basin.

5.1 Analysis Methods

5.1.1 NEPA Requirements for Cumulative Impacts Analysis

Council on Environmental Quality regulations for NEPA implementation describe cumulative effects as "the impact on the environment resulting from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions." (40 CFR 1508.7) This statement has been interpreted in many ways. Guidance from CEQ (1997) provides a helpful summary of general principles that have gained acceptance in the analysis of cumulative effects:

1. *Cumulative effects are caused by the aggregate of past, present, and reasonably foreseeable future actions.* The effects of a proposed action on a given resource include present and future effects added to the effects of past actions. These cumulative effects must be added to the effects (past, present, and future) of all other actions that affect the same resource.
2. *Cumulative effects are the total effect, including both direct and indirect effects, on a given resource no matter who (Federal or non-Federal) has taken the action.* Individual effects from disparate activities may add up or interact to cause additional effects not apparent when looking at individual effects one at a time. The additional effects contributed by actions unrelated to the Proposed Action must be included in the analysis of cumulative effects.
3. *Cumulative effects need to be analyzed in terms of the specific resources being affected.* Environmental effects are evaluated from the perspective of the Proposed Action. Analyzing cumulative effects requires focusing on the resource that may be affected and developing an adequate understanding of how the resources are susceptible to effects.
4. *It is not practicable to analyze the cumulative effects of an action on the universe; the list of environmental effects must focus on those that are truly meaningful.* For cumulative effects analysis to help the decisionmaker and inform interested parties, it must be limited to effects that can be meaningfully evaluated. The boundaries for evaluating cumulative effects should be expanded to the point at which the resource is no longer significantly affected or the effects are no longer of interest to affected parties.
5. *Cumulative effects on a given resource are rarely aligned with political or administrative boundaries.* Cumulative effects analysis on natural systems must use natural ecological boundaries and analysis of human communities must use actual sociocultural boundaries to ensure including all effects.

6. *Cumulative effects may result from the accumulation of similar effects or the synergistic interaction of different effects.* Repeated actions may cause effects to build up through simple addition and the same or different actions may produce effects that interact to produce cumulative effects greater than the sum of the effects.
7. *Cumulative effects may last for many years beyond the life of the action that cause the effects*. Some actions cause damage lasting for longer than the life of the action itself. Cumulative effects analysis needs to apply the best science and forecasting techniques to assess potential catastrophic consequences in the future.
8. *Each affected resource must be analyzed in terms of its capacity to accommodate additional effects.* The most effective cumulative effects analysis focuses on what is needed to ensure long term productivity and sustainability of the resource.

5.1.2 Scope of Analysis

Consistent with the CEQ guidance described above, a cumulative impact would occur if impacts related to the implementation of the Bull Run HCP or the alternatives, added to the environmental impacts of other past, present, and reasonably foreseeable similar actions, resulted in a significant effect. For an impact to be considered cumulative, these incremental impacts and potential incremental impacts must be related to the types of impacts caused by the Proposed Action or Alternatives 1 or 3.

The geographic scope of the cumulative effects analysis is the Sandy River Basin. This is different than the action area, which only includes lands located within the hydrologic boundary of the Sandy River Basin that are associated with and/or potentially affected by activities associated with the alternatives. The geographic scope of the cumulative effects analysis encompasses the action area, but was expanded to the entire Sandy River Basin to include lands on which other activities may occur that could affect resources of concern.

5.1.3 Actions Included in the Cumulative Impacts Analysis

5.1.3.1 Regulations and Plans

Implementation of Federal, state, and local government regulations and plans may interact with the Proposed Action or alternatives to cumulatively affect species and their habitat. Regulations and plans relevant to the analysis of cumulative effects, and the environmental objectives of each, are discussed in this subsection.

Federal Endangered Species Act

The Endangered Species Act was passed in 1973, and it is intended to protect and conserve species listed as endangered or threatened and to conserve the habitats upon which they depend.

Subsection 1.1.2.1, Endangered Species Act, provides a more detailed description of the ESA and its applicability to this project.

The 1982 and 1988 amendments to the ESA require that recovery plans be developed and implemented to promote the conservation of listed species. Recovery plans are guidance documents that contain 1) a description of site-specific management actions necessary to achieve the plan's goal for the conservation and survival of the species; 2) objective, measurable criteria which, when met, would result in a determination that the species should be removed from the list; and 3) estimates of the time and cost required to carry out the measures needed to achieve the plan's goal and to achieve intermediate steps toward that goal.

The Willamette and Lower Columbia River Basins constitute one of four "recovery domains" that NMFS has delineated throughout Washington, Oregon, and Idaho to organize recovery planning for all listed salmon and steelhead in the region. The Sandy River Basin is located within the Lower Columbia River Basin. When completed, the Lower Columbia River Recovery Plan will address the Oregon portions of the following species: Lower Columbia River Chinook salmon, Columbia River chum salmon, Lower Columbia River coho salmon, and Lower Columbia River steelhead.

In addition to this recovery planning process, substantial efforts are under way for the recovery of listed terrestrial species, such as the northern spotted owl. The Northwest Forest Plan (USFS 1994a) established land use objectives for Federal lands in the Pacific Northwest under the jurisdiction of the USFS and BLM. A draft recovery plan addressing both Federal and non-Federal lands is currently under review.

Cumulatively, the Proposed Action and the ESA would continue to improve conditions for listed species in the action area, as compared to current conditions and the No-action Alternative, through compatible resource management goals. As stated above, the objectives of the ESA are to protect and conserve species listed as endangered or threatened and to conserve the habitats upon which they depend. Implementation of the Proposed Action would be consistent with these objectives by furthering habitat protections within the action area. This would be accomplished through measures aimed at protecting riparian and aquatic habitats. Cumulatively, both the No-action Alternative and Alternative 3 would not contribute as effectively as the Proposed Action to ESA objectives of protecting listed species.

Oregon Endangered Species Act

The 1987 Oregon ESA requires the conservation of listed species and defines conservation as "the use of methods and procedures necessary to bring a species to the point at which the measures provided under ORS 496.171 to 496.182S are no longer necessary." ODFW prepares lists of special-status species under the authority of the Oregon ESA, as detailed in Subsection 3.4.1.2, Oregon Endangered Species Act. Lower Columbia River coho salmon, the bald eagle, and the northern spotted owl are listed under the Oregon ESA.

Cumulatively, the Proposed Action and the Oregon ESA would continue to improve conditions for coho salmon, the bald eagle, and the northern spotted owl in the action area, as compared to current conditions and the No-action Alternative, through compatible resource management goals. As stated above, the objectives of the Oregon ESA are to protect and conserve species listed as special-status. Implementation of the Proposed Action would be consistent with these objectives by furthering habitat protections within the action area. This would be accomplished through measures aimed at protecting riparian and aquatic habitats. Cumulatively, both the No-action Alternative and Alternative 3 would not contribute as effectively as the Proposed Action to Oregon ESA objectives of protecting special-status species.

Clean Water Act

The Clean Water Act, enacted in 1972, is the cornerstone of surface water quality protection in the United States. ODEQ designated several segments of the Sandy River, including 6 miles of the lower Bull Run River as "water quality limited" because summer water temperatures were too high for salmon and steelhead. To comply with Clean Water Act requirements, ODEQ completed a Water Quality Management Plan in 2005 to provide a strategy for reducing pollutant discharge. Subsection 1.2.2.2, Clean Water Act, describes the Act and its applicability to this project. In addition to the temperature requirements for the lower Bull Run River, the Water Quality Management Plan includes other actions to address water quality limitations throughout the Sandy River Basin.

Cumulatively, the Proposed Action and the strategies of the Clean Water Act would continue to improve surface water quality conditions within the action area, as compared to current conditions and the No-action Alternative, through compatible resource management goals. As stated above, the strategies of the Clean Water Act are to protect healthy waters and restore impaired ones. Implementation of the Proposed Action would be consistent with these strategies by protecting and restoring aquatic resources within the action area. This would be accomplished through measures aimed at protecting riparian habitat and aquatic resources. Consistent with the Section 303(d) listings,

the Proposed Action would include adaptive management as a primary component to reduce scientific uncertainty and to determine the effectiveness of conservation measures. Cumulatively, both the No-action Alternative and Alternative 3 would not contribute as effectively as the Proposed Action to the objectives of the Clean Water Act.

U.S. Forest Service, Mt. Hood National Forest

Management activities in the Mt. Hood National Forest are guided by the Northwest Forest Plan (USFS 1994a) and the Mt. Hood National Forest Land and Resource Management Plan (USFS 1990). The Northwest Forest Plan was established to protect large blocks of late-successional forest and provide habitat for species that depend on those forests, including the spotted owl. The Northwest Forest Plan also outlines terrestrial and aquatic conservation strategies to prescribe management standards and guidelines to maintain or restore ecological integrity. The purpose of the Mt. Hood National Forest Land and Resource Management Plan is to provide the management direction for the forest and the platform for determining consistency with all land use proposals, including habitat conservation plans. These plans are described in more detail in Subsection 3.2, Land Use.

Cumulatively, the Proposed Action and the Northwest Forest Plan would continue to improve conditions for listed species across the action area, as compared to current conditions and the No-action Alternative, through compatible resource management goals. Implementation of the Proposed Action would be consistent with the purpose of the Northwest Forest Plan by furthering habitat protection, which would be accomplished through conservation measures aimed at protecting riparian and aquatic habitats. Cumulatively, both the No-action Alternative and Alternative 3 would not contribute as effectively as the Proposed Action to the Northwest Forest Plan strategies that protect listed species.

Bureau of Land Management

BLM, in conjunction with private organizations such as the Western Rivers Conservancy and The Nature Conservancy, manages about 20 miles of Wild and Scenic rivers within the Sandy River and Salmon River Watersheds, as well as 9,000 acres in the Mt. Hood Corridor (ODEQ 2005). BLM land management activities are required to comply with Northwest Forest Plan requirements and are managed according to the Salem District BLM Resources Management Plan. The goals of the Salem District BLM Resources Management Plan are similar to those of the Northwest Forest Plan and include the designation of Tier 1 and Tier 2 key watersheds as part of an Aquatic Conservation Strategy (BLM 2005). Tier 1 key watersheds contribute directly to conservation of at-risk anadromous salmonids, bull trout, and resident fish species and have a high potential of being restored as part of a watershed restoration program (BLM 2005).

The BLM is expected to finalize the Sandy River Basin Management Plan in the fall of 2008. The plan will address the long term resource protection and management needs for acquired lands in the Sandy River Watershed. The plan will define and guide the management direction of the BLM Sandy River planning area for the next 10 to 15 years. It will include a conservation strategy for the Sandy River (and its major tributaries) that provides balanced protection and enhancement of values such as recreation, wildlife, vegetation, water quality, scenery, the anadromous fishery and the ecology of the Sandy River Watershed.

Cumulatively, the Proposed Action and the Salem District BLM Resources Management Plan would continue to improve conditions for listed species across the action area, as compared to current conditions and the No-action Alternative, through compatible resource management goals. Implementation of the Proposed Action would be consistent with the purpose of the Salem District BLM Resources Management Plan by furthering habitat protection, which would be accomplished through conservation measures aimed at protecting riparian and aquatic habitats. Cumulatively, both the No-action Alternative and Alternative 3 would not contribute as effectively as the Proposed Action to the Salem District BLM Resources Management Plan strategies that protect listed species.

5.1.3.2 Other Projects

A variety of related future projects are likely to occur in the Sandy River Basin; these projects and their associated actions are described below. In addition, many other actions are likely to occur over the 50-year permit term, such as projects implemented in accordance with the Mt. Hood Land and Resource Management Plan.

Removal of Little Sandy Dam and Marmot Dam by Portland General Electric

PGE is in the process of decommissioning its Bull Run hydroelectric project, which includes Marmot Dam on the Sandy River and Little Sandy Dam on the Little Sandy River. Recently, PGE removed the 47-foot-high Marmot Dam and is now in the process of site restoration. The Little Sandy Dam, which is nearly 16 feet high, will be removed in 2008; other components of the project (i.e., a concrete lined canal, a timber flume, and Roslyn Lake) will be removed in 2009. Dam removal will open up portions of the Sandy and Little Sandy Rivers to salmon and steelhead migration, restore natural flow conditions to the full length of the Little Sandy River, and add flows to the lower Bull Run River below the Little Sandy confluence.

PGE also will transfer about 1,500 acres of lands associated with the hydroelectric project to Western Rivers Conservancy. This organization is acquiring an additional 3,500 acres of land surrounding

PGE's property to create new conservation corridors along 13 miles of the Sandy River and 4 miles of the Little Sandy River. To date, Western Rivers Conservancy has acquired more than 2,900 acres of high quality habitat along 10 river miles in the Sandy River Basin, including 789 acres of forested properties donated by PGE. These corridors will become refuges for fish and wildlife, as well as a public resource for hikers, floaters, anglers, and viewers of salmon and wildlife. The area will be managed by the BLM.

U.S. Forest Service Projects

Mt. Hood National Forest is implementing terrestrial and riparian habitat improvement projects and other related actions throughout the public lands it manages in the Sandy River Basin (see Figure 3.2-1). Projects likely to occur during the permit term include culvert replacement, enhancement of degraded riparian habitat, and placement of spawning gravel and materials to increase habitat complexity.

In addition, USFS manages the Columbia River Gorge National Scenic Area. The USFS is working with local partners to restore habitat conditions in this management unit, including projects near the Sandy River confluence such as forest restoration and recreation improvements. Measures H-8 (reestablish Sandy River mouth) and H-9 (Sandy River channel reconstruction) in the Bull Run HCP would be implemented in cooperation with the USFS.

Bureau of Land Management Projects

As part of its Little Sandy River Large Wood Placement project, BLM will place approximately 75 pieces of large wood in the lower 3 miles of the Little Sandy River prior to the scheduled removal of the Little Sandy Dam in the summer of 2008. The objectives of the project are to increase habitat complexity and trap bedload stored behind the dam, prior to the expected recolonization by anadromous fish species.

Another example of an ongoing BLM project is the Marmot Road Culvert Replacement project. BLM will replace a perched, 42-inch-diameter metal pipe with a stream simulation structure to allow unobstructed fish passage for resident cutthroat trout, restore the natural stream gradient, and arrest the erosion of the roadbed. This project is located at the crossing of Marmot Road (milepost 7.82) and West Creek in the Plympton Creek Watershed. No other special status species are known to occur in the project vicinity (Bureau of Land Management 2007).

Sandy River Basin Aquatic Restoration Strategy

The Sandy River Basin Working Group has completed an Aquatic Restoration Strategy that recommends priority restoration actions based on an assessment of habitat conditions in the Sandy River Basin. The priority watersheds containing the most important anchor habitat for salmon and steelhead are 1) Sandy River Corridor (mouth to Zigzag River confluence); 2) Salmon River; 3) Still Creek; 4) Upper Sandy River (upstream of and including Clear Fork Sandy River); 5) Gordon Creek; 6) Alder and Wildcat Creeks; 7) Little Sandy River Watershed; and 8) Trout Creek. The Aquatic Restoration Strategy proposes a suite of restoration actions based on a survey of 157 known restoration actions and newly developed proposals. Specific restoration actions are proposed throughout the Sandy River Basin Watershed under the general categories of reconnecting isolated habitats, restoring long-term natural processes, restoring riparian vegetation, and enhancing instream habitats. The City developed the HCP in coordination with the Sandy River Basin Partners and intends the HCP measures to be consistent with the Partner's basinwide strategy.

Invasive Weed Removal

The Nature Conservancy owns several properties in the Sandy River Basin. The Nature Conservancy monitors streamside habitats, amphibian populations, and water quality on properties in the Sandy River Basin. Staff and volunteers remove invasive, non-native Scots broom, Japanese knotweed, and Himalayan blackberry.

Sandy Hatchery Improvements

Historically, fish runs on Cedar Creek were significant and supported fish camps. However, fish access to Cedar Creek has been blocked since construction of the Sandy Hatchery in the 1950s. Implementation of conservation measure P-4, Cedar Creek fish passage, in conjunction with ODFW commitments to improve conditions at the Sandy Hatchery (i.e. upgrades to the water intake screens, potential fish passage, and various system enhancements), would provide passage to approximately 12 to 14 miles of stream habitat for coho, winter steelhead, and anadromous cutthroat trout.

5.2 Impacts Analysis

As described in Subsection 5.1.2, Scope of Analysis, the geographic scope of the cumulative effects analysis is the entire Sandy River Basin. The Sandy River Basin encompasses the action area, which only includes lands located within the hydrologic boundary of the Sandy River Basin that are associated with and/or potentially affected by activities associated with the alternatives.

5.2.1 Land Use

Current land uses in the Sandy River Basin are summarized in Table 3.2-1, which reflects the effects of past and present actions in the watershed such as agricultural and urban development, timber management, development of the Bull Run water supply, and continued City management of the water supply system (i.e., the covered activities). Under all alternatives, overall land use patterns in the action area are expected to remain similar to existing conditions and no substantial changes in land ownership are expected. Additional land development is likely to occur in the lower Sandy River Basin consistent with city and county land use plans and policies. In the upper Sandy River Basin, forestry, recreation, and other compatible uses would continue to occur consistent with the Mt. Hood National Forest Land and Resources Management Plan and other applicable plans and policies. The Bull Run Watershed would continue to be managed consistent with Federal legislation to protect water quality in the Bull Run Management Unit. In addition, other future actions (e.g., site-specific actions pursuant to the Sandy River Basin Aquatic Restoration Strategy) would occur in the Sandy River Basin, contributing to the overall cumulative benefit of improving the basin's aquatic and riparian ecosystems consistent with the applicable land use plans and policies.

5.2.2 Vegetation

Current vegetative cover in the Sandy River Basin is summarized in Table 3.3-1, which reflects the effects of past and present actions in the watershed, such as agricultural and urban development, timber management (outside of the Bull Run Watershed), development of the Bull Run water supply, and continued City management of the water supply system (i.e., the covered activities). Under all three alternatives, vegetative cover in the action area is expected to remain similar to existing conditions. Additional land development is likely to occur in the lower Sandy River Basin, which could result in the conversion of upland areas (e.g., farmlands) to urban uses. In the upper Sandy River Basin, forestry, recreation, and other compatible uses would continue to occur consistent with applicable plans and policies. The Bull Run Watershed would continue to be managed consistent with Federal legislation to protect water quality in the Bull Run Management Unit. In the action area, riparian habitat is expected to improve as a result of removing Marmot Dam and Little Sandy Dam, as well as from the various habitat restoration projects (e.g., actions pursuant to the Sandy River Basin Aquatic Restoration Strategy).

Implementation of the Proposed Action would contribute to the overall cumulative benefit to riparian habitat quality in the Sandy River Basin by improving vegetative cover types in the action area through conservation measures such as H-2 (management of City lands along the Bull Run River) and offsite

measures such as H-11 through H-22 (riparian easement acquisition and improvement projects throughout the action area). These measures would not have an immediate effect on vegetative cover, but over time (as tree cover matures, for example) riparian habitat in the action area would improve. Implementation of the Fish Passage Alternative would have little or no effect on riparian habitat or other vegetative cover types in the action area because it does not include riparian habitat conservation measures, and therefore it would not contribute to cumulative effects.

In the action area, key plant species of concern are tall bugbane, white rock larkspur, and peacock larkspur. As discussed in Subsection 3.3.2, Affected Environment, both past and present actions, particularly land development and timber management, have resulted in cumulative impacts to these species in the Sandy River Basin. Future actions in the Sandy River Basin could contribute to additional impacts, but all projects would comply with applicable regulations. In addition, conservation measures implemented in the action area as part of the Proposed Action could contribute to cumulative effects in the Sandy River Basin. Specifically, as described in Subsection 4.3.3, Alternative 2, Proposed Action, the Proposed Action would have no effect on the two larkspur species and only minor effects (positive and negative) on tall bugbane due to riparian easements and restoration. As described in Subsection 4.3.4, Alternative 3, Fish Passage Alternative, this alternative would have no effect on special plant species because it does not include the riparian conservation measures that would be implemented as part of the Proposed Action.

5.2.3 Birds and Mammals

Bird and mammal species of concern in the action area are the bald eagle, northern spotted owl, fisher, and harlequin duck. As discussed in Subsection 3.4.2.2, Bird and Mammal Species Addressed in the Bull Run HCP, past and present actions have resulted in cumulative effects to these species. The bald eagle was recently removed from the list of federally threatened species, primarily as a result of pesticide regulation. Continuation of the existing regulatory framework for eagle protection (see Subsection 3.4.2, Affected Environment) would support eagle recovery. Under all alternatives, future actions in the action area, such as removal of Marmot and Little Sandy Dams and restoration of riparian habitat, would have minor beneficial and adverse effects on bald eagles. Both the Proposed Action and the Fish Passage Alternative contributions to these cumulative effects would be mitigated as a result of the implementation of terrestrial conservation measures.

In the Sandy River Basin, cumulative effects on northern spotted owls and fishers are primarily a result of forest management practices. The effects of past and present actions would continue in the action area under all alternatives, but are mitigated by the Northwest Forest Plan and other regulations

governing forest management, as well as the terrestrial conservation measures included as part of the Proposed Action and Alternative 3. As described in Subsections 4.4.3 and 4.4.4, the Proposed Action and Fish Passage Alternative would have very limited effects on these species; therefore, neither alternative would make a substantial contribution to cumulative effects.

Harlequin ducks are affected by riparian habitat quantity and quality. Cumulative benefits in the Sandy River Basin are likely because of the emphasis on riparian habitat improvement in the action area, especially the removal of Marmot and Little Sandy Dams and associated riparian habitat restoration. Implementation of the Proposed Action and Alternative 3 in the action area would contribute to overall cumulative benefits to instream habitat conditions in the Sandy River Basin through the implementation of flow measures (F-1 through F-4) and temperature measures (T-1 and T-2). In addition, the Proposed Action would improve riparian habitat quality in the action area through conservation measures such as H-2 (management of City lands along the Bull Run River) and offsite measures such as H-11 through H-22 (riparian easement acquisition and improvement projects throughout the action area). These measures would not have an immediate effect on vegetative cover in the action area, but over time (as tree cover matures, for example) riparian habitat would improve resulting in a beneficial cumulative effect on riparian habitat in the Sandy River Basin. Implementation of the Alternative 3 would have a similar contribution to instream cumulative effects because it includes the flow and temperature management measures that would be implemented as part of the Proposed Action. However, Alternative 3 would have little or no effect on riparian habitat or other vegetative cover types in the action area because it does not include riparian habitat conservation measures, and therefore it would not contribute to beneficial cumulative effects in the Sandy River Basin.

5.2.4 Amphibians and Reptiles

As described in Subsection 3.5.2.1, Amphibian Species Addressed in the Bull Run HCP, and Subsection 3.5.2.2, Reptile Species Addressed in the Bull Run HCP, key species of concern in the action area are the western toad, Cascades frog, northern red-legged frog, coastal tailed frog, Cope's giant salamander, Cascade torrent salamander, clouded salamander, Oregon slender salamander, western painted turtle, northwestern pond turtle, and Larch Mountain salamander. These species have been affected by past and present actions in the Sandy River Basin, such as timber management (outside of the Bull Run Watershed), development of the Bull Run water supply, and continued City management of the water supply system (i.e., the covered activities). Under all three alternatives, these species would continue to be affected by activities in the action area, such as instream flow and

temperature changes associated with operation of the Bull Run water supply system (e.g., coastal tailed frog, Cascade torrent salamander) and forest management practices (e.g., clouded salamander, Oregon slender salamander) in the upper Sandy River Basin. Other actions in the Sandy River Basin, including implementation of policies consistent with the Northwest Forest Plan, would help mitigate the cumulative effects on most of these species.

Managing flows and enhancing riparian habitat conditions under the Proposed Action would further benefit the northern red-legged frog, coastal tailed frog, Cope's giant salamander, and Cascade torrent salamander in the action area resulting in positive cumulative effects in the Sandy River Basin. The Proposed Action would have limited to no contribution to cumulative effects (beneficial or adverse) for the western toad, Cascades frog, clouded salamander, Oregon slender salamander, western painted turtle, northwestern pond turtle, and Larch Mountain salamander. Contributions to cumulative effects under the Fish Passage Alternative would be slightly lower than those described for the Proposed Action since no offsite conservation measures would be implemented in the action area.

5.2.5 Hydrology

Cumulative effects on hydrology in the Sandy River Basin are a result of several past and present actions, including construction of dams by PGE and the City of Portland, and land management activities, such as timber management and conversion of land to agricultural and urban uses. These actions have resulted in changes in the timing of flows and the export of water from the Sandy River Basin. Future actions, especially removal of Marmot Dam and Little Sandy Dam, would contribute to a return to more natural flow conditions in the action thereby contributing to a positive cumulative effect on hydrology of the Sandy River Basin. Both the Proposed Action and the Fish Passage Alternative would contribute to cumulative hydrologic effects in the action area by altering flow requirements on the Bull Run River. These conservation measures are intended to benefit fish and would have seasonal effects on the overall hydrologic patterns of the Bull Run River – and therefore a limited contribution to cumulative effects in the Sandy River Basin. The Proposed Action would help to restore more natural hydrologic conditions on Cedar Creek in the action area as a result of the purchase of water rights (Measure F-5) resulting in a positive contribution to cumulative effects in the Sandy River Basin; these additional contributions to cumulative hydrologic benefits would not occur under the Fish Passage Alternative.

Cumulative effects to water supply in the action area could occur as a result of flow changes under all of the alternatives. Other actions potentially affecting the City's Bull Run water supply are those occurring in the Bull Run Watershed, such as actions by other landowners (e.g., Mt. Hood National

Forest). Because of the Federal protected status of the Bull Run Watershed (e.g., Bull Run Management Unit), there are very few actions in the watershed that would contribute to water supply impacts. Therefore, no cumulative effects to water supply in the Sandy River Basin would occur.

5.2.6 Water Quality

In Subsection 4.7, Water Quality, the effects on water quality in the action area are described in terms of temperature, turbidity, dissolved oxygen, and nutrients. Cumulative effects on temperature are a result of past and present actions in the Sandy River Basin such as dam construction and timber management. The re-establishment of natural flow conditions and restoration of riparian habitat resulting from the removal of Marmot Dam and Little Sandy Dam in the action area is expected to improve temperature conditions. In addition, implementation of the Sandy River Basin TMDL and Water Quality Management Plan would be expected to provide similar temperature benefits at restoration sites throughout the Sandy River Basin. The Proposed Action would contribute to a cumulative beneficial effect on water quality in the Sandy River Basin by implementing Bull Run River flow and temperature measures and offsite conservation measures in the action area. Alternative 3 would provide a similar contribution to cumulative temperature benefits as the Proposed Action with the exception of the offsite riparian conservation measures, which would not be implemented as part of this alternative.

Cumulative effects to water quality are primarily a result of physical disturbances in the Sandy River Basin (e.g., timber and road management). Mitigation for these cumulative effects has been established in the form of existing laws and regulations, such as the regulatory program of the Oregon Department of State Lands and management plans consistent with the Northwest Forest Plan. Under the Proposed Action, short term impacts from land disturbance associated with habitat restoration would occur in the action area, contributing to effects in the Sandy River Basin. However, mitigation of these effects would occur in accordance with existing regulations. The offsite conservation measures implemented as part of the Proposed Action would provide a long term benefit in the action area that when combined with similar habitat restoration measures in the Sandy River Basin would result in a beneficial cumulative effect creating more natural riparian habitat throughout the basin. Because the Fish Passage Alternative does not include offsite conservation measures, it would not result in a long term cumulative benefit.

Implementation of the Proposed Action or Alternative 3 would result in a minimal effect on drinking water quality in the action area. For example, operation of the Bull Run water supply to meet water temperature conditions in the lower Bull Run River would slightly lower the temperature of the water

entering the water distribution system in the early part of the summer and raise the average water temperature by approximately 1.8°F (1°C) during late August and September. This change will not affect the City of Portland's ability to meet Federal and state drinking water regulations. Drinking water quality is influenced almost entirely by activities within the federally protected Bull Run Management Unit; as such, no other actions in the Sandy River Basin would result in cumulative effects.

5.2.7 Fish

Cumulative impacts to fish habitat and special-status species are described in this subsection. Fish habitat in the Sandy River Basin is detailed in Subsection 3.8.2.1, Fish Habitat in the Sandy River Basin. Adverse cumulative effects to stream habitat diversity, water temperatures, and food resources have occurred as a result of past and present actions in the Sandy River Basin. Stream habitat diversity in the Sandy River Basin has been reduced by loss of large wood recruitment and physical channel manipulations that have occurred as a result of development or flood control measures. Food resources in the Sandy River Basin are depressed relative to historical conditions, likely a result of low nutrient levels (related to fish populations). These conditions are a result of past and present actions in the Sandy River Basin, such as agricultural and urban development, timber management (outside of the Bull Run Watershed), development of the Bull Run water supply, and continued City management of the water supply system (i.e., the covered activities).

Key fish species of concern are Chinook salmon (fall and spring), winter steelhead, and coho salmon. The other species of concern are chum salmon, rainbow trout, coastal cutthroat trout, Pacific lamprey, western brook lamprey. All of these species have been affected by past and present actions that have affected habitat conditions in the Sandy River Basin (briefly summarized above).

The overall regulatory context discussed above in Subsection 5.1.3, Actions Included in the Cumulative Impacts Analysis, is especially relevant to the analysis of cumulative effects on key fish species of concern, in addition to actions in the Sandy River Basin. A Recovery Plan is currently being prepared that will address the Oregon population of fall and spring Chinook salmon, winter steelhead, and coho salmon. These efforts are being coordinated by a Technical Recovery Team (TRT), which includes experts from NMFS and ODFW. TRT reports indicate that the Sandy River Basin provides habitat for "core" and "genetic legacy" populations of Chinook salmon (fall and spring) and winter steelhead (core only) (Willamette-Lower Columbia TRT 2003).

The TRT describes core populations as those sustaining the species' evolutionary legacy and offering the most likely path to recovery. Genetic legacy populations are those with minimal influence from hatchery fish or those exhibiting important life history characteristics that are no longer found throughout much of the species' historical range. In addition, it is likely that the Sandy River Basin population of coho salmon would be considered as core and (possibly) genetic legacy populations (personal communication with Patty Dornbusch, National Marine Fisheries Service, Salmon Recovery Division, Recovery Coordinator, July 20, 2007). This species was not listed under the ESA at the time the core and genetic legacy populations were originally determined.

Issuance and adoption of a Recovery Plan (scheduled for 2008) is expected to include actions in the Sandy River Basin to promote core and genetic legacy populations. These actions are likely to be similar to the currently proposed actions described above in Subsection 5.1.3.2, Other Projects. These actions in the Sandy River Basin, together with the effects of the Proposed Action in the action area, are expected to provide a cumulative benefit to fish species by increasing habitat diversity, lowering water temperatures, providing access to additional habitat, and potentially increasing food supplies. In combination with the Recovery Plan and similar projects in the Sandy River Basin, implementation of the conservation measures in the action area under the Proposed Action would contribute to these cumulative fish habitat benefits.

Alternative 3 also would contribute to cumulative fish habitat benefits in the Sandy River Basin in a manner similar to the Proposed Action. However, benefits would primarily be the result of providing access to additional habitat rather than enhancing existing habitat in the action area. Overall changes are similarly beneficial (see Subsection 4.8.4, Alternative 3, Fish Passage Alternative), with higher benefits to winter steelhead and lower benefits to fall Chinook salmon, spring Chinook salmon, and coho salmon than under the Proposed Action. The contribution to cumulative benefits associated with the offsite conservation measures would not occur under the Fish Passage Alternative.

5.2.8 Socioeconomics and Environmental Justice

Water rates in the City of Portland's water service area are influenced by many factors, including the City's operation of the Bull Run water supply system (i.e., the covered activities) and its natural resources management efforts in the Bull Run Watershed. The Proposed Action and Alternative 3 would slightly increase water rates. Rates are not directly affected; however, by the habitat restoration actions of other organizations in the watershed. As a result, there is no cumulative effect to water rates. As indicated in Table 3.9-7, the minority and low income population in the Sandy River Basin is not

disproportionate to the general population. Therefore, there is no cumulative Environmental Justice impact.

5.2.9 Cultural Resources

As described in Subsection 3.10.2, Affected Environment, archeological resources are known to occur throughout the Sandy River Basin. Additional cultural resources (currently undiscovered) are likely to occur throughout the Sandy River basin, especially along streams. Cumulative impacts to known cultural resources have occurred as a result of past and present actions in the Sandy River Basin, but impacts to currently unknown resources would only occur as a result of future actions in the basin. All potential future actions in the Sandy River Basin that cause ground disturbance would have the potential to affect subsurface archeological resources. Where applicable, these actions in the Sandy River Basin would take place in accordance with various laws and regulations governing the protection of cultural resources – typically Federal actions (including federally funded actions) and timber management actions conducted according to the Oregon Forest Practices Act. These requirements provide mitigation for cumulative effects. Both the Proposed Action and the Fish Passage Alternative have the potential for cultural resources impacts in the action area (see Subsection 4.10.3 and 4.10.4, respectively), but would be implemented in accordance with a Cultural Resources Management Plan. Following the Management Plan guidelines, impacts from both alternatives in the action area would effectively be mitigated thereby reducing their contribution to cumulative effects to cultural resources impacts.

5.2.10 Air Quality

Under the Federal Clean Air Act, the cumulative impact of multiple sources generating criteria pollutants (e.g., carbon monoxide) is regulated by the designation of a nonattainment area and implementation of an air quality attainment plan. As described in Subsection 3.11.2, Affected Environment, the entire Sandy River Basin is in attainment for all criteria pollutants. In addition, all timber management activities on private land in the Sandy River Basin would be conducted according to the Oregon Forest Practices Act, which includes air quality protections (e.g., slash burning requirements). Because the action area is in the Sandy River Basin attainment area and because of the existing regulatory setting, air quality impacts of the Proposed Action and Fish Passage Alternative would not contribute to a significant cumulative effect.

5.2.11 Recreation

Recreation resources in the Sandy River Basin include sport fishing and whitewater boating (rafting and kayaking). Cumulative impacts to sport fishing would be similar to cumulative impacts to the fisheries themselves, which are described above in Subsection 5.2.7, Fish. Furthermore, the contribution to cumulative recreation impacts in the Sandy River Basin from the Proposed Action and Fish Passage Alternative are the same as described in Subsection 5.2.4.

In regard to boating, future actions in the Sandy River Basin are expected to result in both beneficial and adverse cumulative effects. Beneficial effects would result from changes in access to streams in the Sandy River Basin relating to the removal of Marmot Dam (complete) and Little Sandy Dam (expected to occur in 2008). The two dam removal projects would provide access to additional boating areas in the Sandy River Basin. However, these projects also could contribute to adverse effects by changing the rate and timing of releases for the benefit of whitewater recreation – i.e., boating conditions would be dictated by natural hydrologic conditions. Neither the Proposed Action nor the Fish Passage Alternative would offer a substantial contribution to these adverse and beneficial cumulative effects in the action area. In addition to flow related effects, several other projects in the Sandy River Basin include the placement of large wood into watercourses. Such placement in boating areas could conflict with safe boating practices. Large wood placement in the action area as part of the Proposed Action would contribute to this cumulative recreation impact; no contribution would occur under the Fish Passage Alternative.